



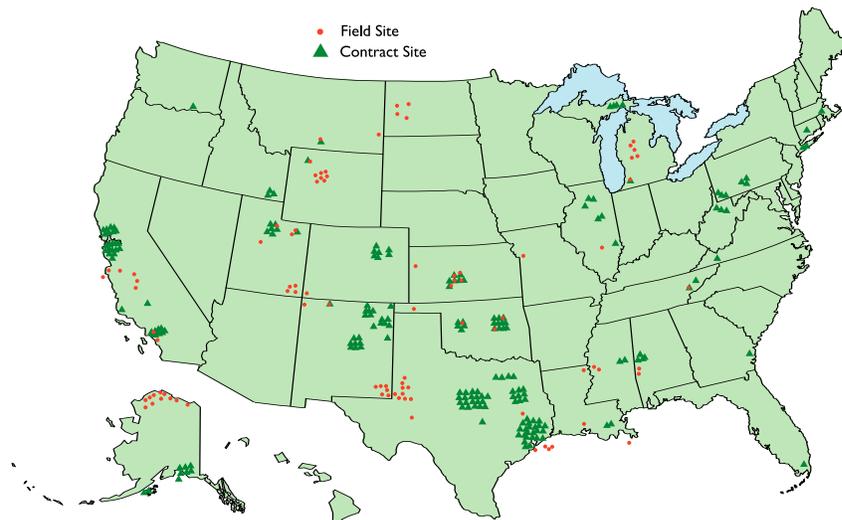
NETL oil E&P research benefits States, industry, Nation

U.S. Department of Energy oil research programs have underpinned America's petroleum technology leadership for decades.

Some of the most important exploration and production technology advances of the past century had their roots in research programs conducted under DOE/NETL or predecessor organizations. A sampling of those advances includes the first:

- Waterflood research (1920s).
- Mud-pulse telemetry—paving the way for downhole data gathering (1970s).
- Chemical enhanced oil recovery (1970s).
- Polycrystalline diamond compact (PDC) drillbits—now one third of the market (1980s).
- Through-casing resistivity tool, for downhole logging (1990s).
- Cross-well seismic, for subsurface imaging (1990s).
- Three-phase relative permeability measurement (1990s).
- 4-D seismic imaging (2000s).
- Borehole seismic instruments (2000s).

Beyond those firsts, DOE oil research has been hugely influential in developing and shaping other critical technology trends in America's oil and gas industry. In a landmark 2001 report assessing the worth of energy research at DOE, the National Research Council (NRC) looked at the most important fossil energy technology innovations during 1978-2000, when the Federal government expended \$91.5 billion in energy R&D, mostly through DOE programs. At the time, NRC noted that the Federal government had been the largest single source



NETL's oil E&P project locations.

and stimulus of energy R&D funding for more than 20 years.

Program benefits

In the area of E&P technology, NRC cited DOE's oil drilling, completion, and stimulation (DCS) program for its important contributions to the development of PDC bits, horizontal drilling, slimhole and coiled tubing drilling, synthetic drilling fluids, and cuttings injection. The council also cited the oil program's significant environmental benefits, such as smaller footprints for drilling-production operations, reduced noise, lower toxicity of discharges, reduced fuel use, and better protection of sensitive habitats.

DOE's own findings estimated economic benefits from the oil DCS programs dating from 1978 to 2000 at \$2.2 billion. NRC credited \$1 billion in direct benefits from DOE's contributions to the DCS program and concluded that while it could not verify the basis for DOE's assessment of benefits, "...it is certainly obvious that DOE has made a contribution well in excess of its outlay."

Overall, NRC estimated that DOE's investment of \$1.57 billion in oil and gas E&P research generated net economic benefits to the Nation totaling \$6 billion during 1978-

2000 and yielded incremental production of 527 million barrels of oil.

NRC singled out DOE's seismic technology and EOR programs for their contributions to the Nation's oil reserves at 360 million barrels and 167 million barrels of oil equivalent, respectively. The seismic program was credited with realizing economic benefits of \$600 million; the EOR program was said to have provided \$625 million in cost savings to oil producers and nearly \$90 million in incremental Federal and State revenues.

DOE's involvement in the field demonstration program was expected to have resulted in 1.29 billion barrels of incremental oil production and 1.74 trillion cubic feet of incremental gas production during 1996-2005. This yields economic benefits from royalties on Federal lands and increased State severance taxes that NRC pegged at \$2.2 billion.

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This departure from the usual format is a special issue of E&P Focus that highlights the benefits of NETL's oil E&P research programs.



Overall, NRC concluded, “DOE’s program appears to have met its objectives of expanding the oil and gas resource base and increasing domestic production of oil and gas in response to mandates from Congress or the Administration. It did this by utilizing DOE expertise and emphasizing high-risk projects. Also, DOE supports smaller companies and independent oil and gas producers, which make up a significant portion of the production capacity in the United States and which have limited resources to undertake R&D programs.”

Benefits to States

Most States garner direct economic benefits from DOE oil and gas research programs. The 327 active DOE oil and gas R&D projects as of fiscal 2003 had resulted in the creation of 24,515 direct and indirect jobs in 37 States and the District of Columbia, according to a U.S. Department of Commerce formula. The benefits aren’t limited to the oil and gas producing States, as 29 projects representing almost 1,500 jobs were in States that produced no oil or gas in that fiscal year.

Among only the oil E&P projects that were active as of fiscal 2005-2006, 128 projects were awarded in 26 States, representing a combined value of \$144 million (Table 1).

Of course, projects awarded in one State sometimes involve research affecting another State’s resources. For example, a University of Houston project conducted in Houston, TX, ascertained the optimal design for a carbon dioxide WAG (water-alternating-gas) flood of shallow, heavy oil reservoirs on Alaska’s North Slope, which could be the key that unlocks a resource estimated at 10-20 billion barrels of oil. That would be a huge boost not only to Alaska’s economic future, as the State faces declines in its mature North Slope fields, it also would help bolster the Nation’s energy security.

DOE for years has provided financial support to the Interstate Oil and Gas Compact Commission (IOGCC) for programs that focused on regulatory streamlining, produced-water issues, oil and gas drilling and production data, and energy education.

An annual IOGCC program, supported by DOE funding, compiles a catalogue of oil and gas incentive programs to assist State

governments in developing and enhancing new and existing oil and gas incentives.

NETL’s oil research program projects produce several different types of benefits, including increased production, increased economically recoverable resources (ERR), reduced cost of production or recovery, reduced environmental impacts, and improved economic benefits. Those benefits to the Nation’s economy include higher Federal royalty and tax payments to the U.S. Treasury, increased severance and production tax revenues, greater State tax revenues, and expanded private lands royalties.

In all, the projected cumulative economic benefits to all stakeholders emanating from NETL’s oil R&D programs would total almost \$215 billion over the next 20 years, based on oil price projections from the Energy Information Administration’s latest

annual energy outlook (Table 2).

Meeting metrics

NETL undertakes a variety of internal self-assessments of its programs to meet certain metrics required by Federal law to validate a program’s worth.

One such self-assessment in FY 2004 set an overall program target of increasing oil ERR by 52 million barrels. NETL selected five oil E&P projects out of more than 230 active in that fiscal year. Those five projects alone accounted for 77 million barrels of incremental oil ERR, exceeding the overall program target by 25 million barrels.

The five projects were:

- An effort to use remote sensing to identify oil exploration leads under a lake on the Fort Berthold reservation—NETL’s Native American program. This project identified 11 oil prospects with an estimated 9 million barrels of oil ERR.
- Development of an intelligent computing system for reservoir analysis and risk assessment of the Red River formation in North Dakota—NETL’s Class Revisits program. This project yielded another 7 million barrels of oil ERR.
- Design and testing of novel waterflood techniques in the Spraberry Trend area of Texas—NETL’s PUMP (Preferred Upstream Management Practices) program. This project added 8 million barrels of oil ERR.
- Implementing a novel cyclic CO₂ flood in Michigan Basin reef fields. This project was expected to result in the ultimate added ERR of 40 million barrels of oil, if the technology were adopted basin-wide.
- Using advanced reservoir characterization and thermal production technologies to increase heavy oil reserves and production in Southern California’s giant Wilmington field—NETL’s Class III program. This project boosted ERR by about 13 million barrels in the project area alone. If expanded to the rest of the field, reserves could be boosted by 526 million barrels of oil.

Over the long term, NETL’s oil program target is to add 2.3 billion barrels of oil ERR by 2025.

Technology transfer

Technology transfer goes to the heart of DOE’s oil research mission.

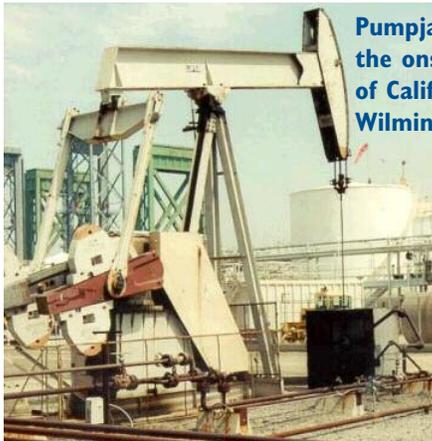
ST	No. of projects	Value of projects		
		DOE	Performer	Total
— Thousand \$ —				
AK	2	1,664	701	2,365
AL	2	826	552	1,378
CA	21	15,145	5,591	20,736
CO	4	1,591	475	2,066
CT	1	1,009	200	1,209
DC	1	74	0	74
ID	6	1,222	208	1,430
IL	2	437	136	573
KS	4	2,186	983	3,169
LA	1	622	243	865
MA	1	941	550	1,491
MI	5	3,861	1,730	5,591
MO	1	642	675	1,317
MS	3	2,939	751	3,690
MT	1	430	90	520
NM	16	12,194	5,791	17,985
NV	1	1,416	377	1,793
NY	1	800	200	1,000
OK	10	4,939	3,256	8,195
PA	4	3,184	807	3,991
TN	2	1,017	135	1,152
TX	30	29,005	17,721	46,726
UT	4	2,235	568	2,803
VA	1	11,219	0	11,219
WA	1	160	0	160
WY	3	1,900	583	2,483
Totals	128	101,658	42,323	143,981

* Active as of FY2005-2006

Innovations emerging from NETL's oil program do little good unless the Nation's petroleum producers are made aware of them and deploy them in actual E&P operations.

The oil and gas industry in the United States today has a much different character than it did prior to 1980. No longer does "Big Oil" dominate the makeup of America's oil and gas sector. For the most part, the major oil companies have focused their attention on more-lucrative prospects outside of the United States.

Independent oil and gas producers—small businesses typically employing no more than 10 full-time employees—now drill 85 percent of the Nation's wells and produce nearly 60 percent of the oil in the Lower 48 States. Most of these companies, however, work with small financial margins and have few resources to risk on developing technological solutions to the problems they encounter in their fields.



Pumpjack at work in the onshore portion of California's giant Wilmington field.

Without DOE participation, new technologies are usually accessible only to major oil companies because of the capital equipment expenditure required, perceived risk, or the proprietary nature of the technology.

When a technology is first developed through NETL programs, whether by private or Federal researchers, it is available to the industry for immediate use. These new technologies are then licensed and made available for industry use either by a service company or the research laboratory involved. Even after commercialization, NETL continues to develop the technology via increased efficiencies or decreased costs. The idea is to make innovative technology accessible to smaller producers.

As such, communicating data and results

**Table 2
NETL oil program economic benefits***

Economic benefit—increases in:	Million \$
Federal tax revenues	24,837
Federal lands royalties	10,767
Severance and production tax revenues	9,770
State tax revenues	4,080
Total Federal & State revenues and royalties	49,454
Private lands royalties	16,933
Total economic activity	214,723

*Cumulative values for 2006-2025, based on oil price projections from EIA's 2006 Annual Energy Outlook.

from NETL oil and gas research projects to the industry community is important to the future viability of America's oil and gas industry. So DOE has made oil and natural gas technology transfer targeted specifically to small independent producers one of its highest priorities.

NETL implements a wide range of methods to disseminate technology information. They include brochures and other materials, newsletters, websites, reports, project fact sheets, and information booths at trade shows and conferences. In the past calendar year alone, almost 6,000 CDs on technology topics were distributed at trade shows and conferences on such topics as slurry technology, microhole technology, coalbed natural gas, South-Central Alaska gas recovery methods, a compilation of major oil reservoirs in the Permian Basin, Class Field Demonstration Project summaries, the PC Pipe Talley Sheet program, newsletters, and software.

In addition to attending and presenting at numerous industry conferences and workshops each year, NETL uses the services of the Petroleum Technology Transfer Council (PTTC) to ensure the widest dissemination of effective technology. DOE helped industry create PTTC in 1993. It is a non-profit, industry-driven organization created to transfer E&P technology to U.S. oil and gas producers through programs that meet the technology needs of its customers, primarily independent producers. PTTC conducts most of its technology-transfer activities through 10 regional lead organizations, each

representing an oil and gas producing area that may have similar geologic features and technology needs.

The big picture

Ultimately, NETL's mission goes beyond giving a hand up to small independents and thus keeping the domestic oil producing industry thriving. NETL oil E&P research and technology dissemination also are undertaken with the idea that these efforts will help to bolster the Nation's energy security as well.

DOE's oil E&P program has its roots in a government response to the oil embargo of 1973-1974. The program was launched with the intent of increasing domestic oil production in order to reduce U.S. reliance on oil imports.

Today, concerns grow not only over growing U.S. dependency on oil from unstable regions but also over the very long-term sustainability of the global oil resource itself. Even as there is greater consideration of unconventional oil resources as a long-term solution to this challenge, it is important to remember that America still has a massive untapped conventional oil resource.

Of America's total remaining discovered oil resource estimated at 407 billion barrels of original-oil-in-place, about 218 billion barrels lying at <5,000 feet is thought to be recoverable with near-to-midterm advanced technologies. At a conservative 10% incremental recovery threshold, that yields a volume close to the current estimate of total remaining proved oil reserves in the United States. Most of this targeted resource lies in mature producing areas.

Even a relatively modest step-change in technology adopted to pursue these "stranded barrels," such as NETL's Microhole Initiative, could revitalize declining oilfields across the Nation, return U.S. oil production to an upward growth path, and spur the creation of tens of thousands of jobs while boosting Federal, State, and Tribal revenues.

In sum, NETL's oil E&P technology research programs have helped industry find and produce more oil in a cost-effective manner that upholds ecologically sound practices. That strengthens the Nation's economy, environment, and energy security, benefiting all Americans.

Calendar of Events/2006

2006

Feb. 2-3

NAPE, North American Prospect Exposition, Houston, TX.
Contact: www.nape@landman.org.

Feb. 7-8

IADC, Health, Safety, Environment & Training Conference & Exhibition, Houston, TX. Contact: www.iadc.org.

Feb. 21-23

IADC/SPE, Drilling Conference, Miami, FL. Contact: www.iadc.org.

Mar. 8

IADC, Spring Meeting, Houston, TX. Contact: www.iadc.org.

Mar. 28-29

IADC/SPE, Managed Pressure and Underbalanced Operations Conference & Exhibition, Galveston, TX. Contact: www.iadc.org.

Apr. 4-5

SPE/IcoTA, Coiled Tubing & Well Intervention Conference & Exhibition, The Woodlands, TX.
Contact: www.spe.org.

Apr. 9-12

AAPG, Annual Convention, Houston, TX.
Contact: www.aapg.org.

Apr. 22-26

SPE, Improved Oil Recovery Symposium, Tulsa, OK.
Contact: www.ior2006.org.

May 1-3

IOGCC, Midyear Meeting, Point Clear, AL.
Contact: www.iogcc.state.ok.us.

May 1-4

SPE, Offshore Technology Conference, Houston, TX.
Contact: www.octnet.org.

May 18

IADC, Drilling Onshore America Conference & Exhibition, Houston, TX. Contact: www.iadc.org.

June 12-14

IPAA, Midyear Meeting, Naples, FL.
Contact: www.ipaa.org/meetings.

June 12-16

API, Exploration & Production Standards Conference on Oilfield Equipment & Materials, Atlanta, GA.
Contact: www.api.org/events.

Sept. 20-22

IADC, Annual Meeting, San Antonio, TX.
Contact: www.iadc.org.

Sept. 25-27

SPE, Annual Technical Conference & Exhibition, San Antonio, TX. Contact: www.spe.org.

Oct. 1-6

SEG, International Exposition & Annual Meeting, New Orleans, LA. Contact: www.seg.org.

Oct. 15-17

IOGCC, Annual Meeting, Austin, TX.
Contact: www.iogcc.state.ok.us.

Oct. 23-25

IPAA, Annual Meeting, Grapevine, TX.
Contact: www.ipaa.org/meetings.

Nov. 28-29

IADC, Drilling Gulf of Mexico Conference & Exhibition, Houston, TX. Contact: www.iadc.org.

E&P Focus is a publication of the U.S. Department of Energy's National Energy Technology Laboratory. It features highlights of DOE's Oil E&P research program.

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